Chennakesava Kadapa, PhD, AFHEA

Mechanical Engineer with expertise on

- Solid Mechanics
- Fluid Mechanics
- Finite Element Analysis
- Isogeometric Analysis
- Hyperelastic materials
- Computational Fluid Dynamics
- Time integration schemes
- Immersed Boundary Methods
- Fluid-Structure Interaction
- High Performance Computing

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Education

• **Doctor of Philosophy** in Mechanical Engineering Swansea University, Swansea, United Kingdom.	**2010 - 2013**	
• **Master of Technology** in Mechanical Engineering Indian Institute of Technology, Kanpur, India.	**2006 - 2008**	**9.25/10 (Distinction)**
• **Bachelor of Technology** in Mechanical Engineering G. Pulla Reddy Engineering College, Kurnool, India.	**2002 - 2006**	**87.4% (Distinction)**
• **Higher education** in Maths, Physics, Chemistry	**2000 - 2002**	**96.1% (Distinction)**
• **Secondary School Certificate**	**1999 - 2000**	**90.0% (Distinction)**

Honours and awards

- 2010 - 2013: Prestigious **Zienkiewicz Scholarship** for PhD from Swansea University, UK.
- 2010: **Six-Sigma** Green-belt certification award for process improvement from GE.
- 2006 - 2008: Scholarship for master's degree in IITs from Ministry of Human Resource Development, Government of India. (**All India Rank 77 (top 1%)** in entrance test in Mechanical Engineering.)
- 2002 - 2006: **Prathibha Merit Scholarship** by the Andhra Pradesh state government, India.

Membership of professional bodies

- Associate Fellow of the Higher Education Academy (AFHEA)
- Member of the UK Association for Computational Mechanics (UKACM)
- Member of the American Society of Mechanical Engineers (ASME)
- Member of the Institution of Engineering and Technology (IET)

Peer reviewing for scientific journals and conferences

1.) Journal of Computational Physics
2.) Energy Conversion and Management
3.) International Journal for Numerical Methods in Engineering
4.) Engineering Computations
5.) Multidiscipline Modeling in Materials and Structures
6.) Proceedings of the ICE - Engineering and Computational Mechanics

Software proficiency

1.) **Programming languages:** C, C++, Fortran, MATLAB, Python, Bash shell, AWK, HTML/CSS
2.) **High-performance computing:** OpenMP, OpenMPI, Petsc, VTK, Score-P, Scalasca, TAU
3.) **Build tools and KDEs:** GNU Make, CMake, VS Code, Kdevelop
4.) **Matrix libraries:** Eigen, PETSc, MUMPS, UMFPACK, SuperLU, PARDISO
5.) **CAD:** AutoCAD, CATIA, Unigraphics, SolidWorks, FreeCAD
6.) **CAE:** HyperMesh, Gmsh, ANSYS
7.) **Visualisation:** Matplotlib, VTK libraries, ParaView
8.) **Text processing:** LaTeX, Bash, AWK

Work experience

W.1.) Research Software Engineer, Swansea University, UK. **Jul-2018 to present**

- Currently parallelising a preprocessor for CFD simulations using ParMetis.
- Developed Python wrappers for calling ANSYS CFX solver for FSI problems using a staggered approach.
- Developed the software framework for running live CFD simulations on a Raspberry Pi cluster for the public outreach event focussed at promoting STEM subjects at the Swansea Science Festival 2018.
- Delivering training courses and workshops on research software development and HPC skills.
- Published two papers on my **independent research work** on novel numerical methods for Computational Solid Mechanics.

W.2.) Research Officer, Swansea University, UK. **Oct-2013 to Jun-2018**

Project: Coupled flow simulations of large-scale geomechanical models. Oct-2017 to Jun-2018

- **Project funding: £49,000.**
- Parallelised the existing Fortran code for HPC platforms using MPI and PETSc libraries.
- Successfully performed simulations on models of sizes up to 50 million elements.
- Implemented Prism and Pyramid elements for simulating models with arbitrary meshes.
- Developed and implemented new B-bar element for quadratic triangular and tetrahedron elements.

Project: Computer modelling of check valves in the VCT system. Oct-2013 to Sept-2017

- **Project funding: £250,000.**
- Developed an innovative numerical formulation and built it into a software tool, developed from scratch, using advanced programming concepts in C++ and various third-party libraries for Matrix Algebra, Computer Graphics and Visualisation.
- Parallelised the numerical framework for HPC platforms and successfully performed large-scale FSI simulations of sizes up to 10 million DOFs.
- Performed validation studies and simulations for industrial problems involving complex geometries.
- Installed the software tool at the industrial collaborator, Schaeffler Technologies, Germany, and trained Schaeffler researchers on using the tool.
- Assisted in coursework and supervised masters and PhD students.

W.3.) Engineer at General Electric Aviation, Bengaluru, India. **Aug-2008 to Sept-2010**

- Developed 2D and 3D finite element models for the turbine rotor components of GE's CF6, CF34, CFM56 and HF120 engines using Unigraphics, Hypermesh and ANSYS.
- Developed an innovative modelling practice for the finite element analysis of elastic-plastic material models and simulated the assembly process of HF120 engine turbine retainers. Was successful in getting this practice **approved as the best practice by the review board**.

Workshops and training events

1.) Delivered Shell and HPC training, 28 March, Swansea, 2019.

2.) Delivered Shell and HPC training, 22 February, Swansea, 2019.

3.) Assisted in "*SA2C minisymposium*", Swansea University, 13 September, Swansea, 2018.

4.) Participated in "*Dirac Day*", Swansea University, 12 September, Swansea, 2018.

5.) Participated in "*Nvidia Hackathon*", Swansea University, 9-11 September, Swansea, 2018.

Contributions to Computational Mechanics

1.) Novel finite element formulation for computational solid mechanics using Bézier elements.

- Independent research contribution.
- Unified formulation for statics, implicit and explicit dynamics, and wave propagation.
- Efficient in dealing with volumetric and shear locking.
- Unstructured triangular and tetrahedral meshes using existing mesh generators.
- Nearly and truly incompressible hyperelastic and elastoplastic materials.

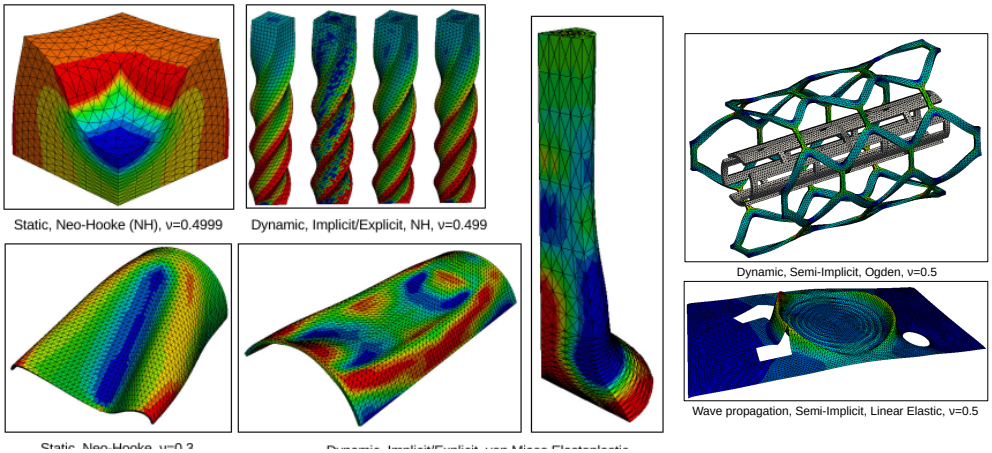

Figure: Simulation capabilities of the proposed finite element framework.

2.) A novel numerical framework for fluid-structure interaction in complex geometries.

- Large structural deformations and solid-solid contact.
- Local refinement capability using hierarchical b-splines.
- Second-order accurate time integration and staggered schemes for computational efficiency.
- Parallelisation for distributed-memory HPC.

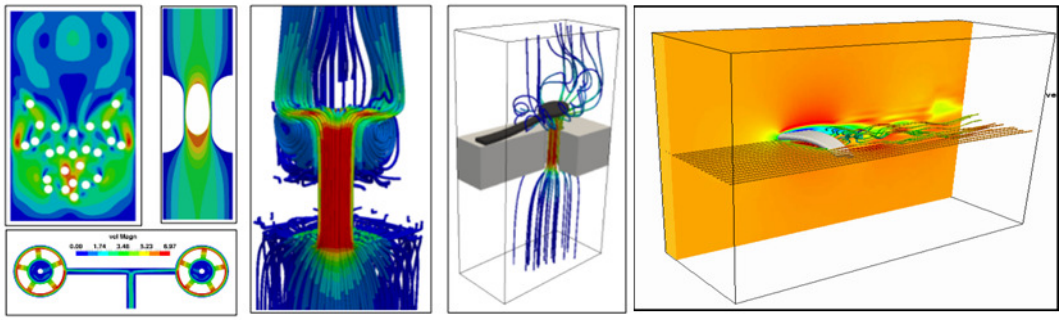

Figure: Snapshots of FSI simulations performed using the FSI tool I have developed.

3.) Mixed Galerkin and least-squares formulations for NURBS based isogeometric analysis.

- Mixed displacement-pressure formulations and LBB-stable combinations.
- Incompressible hyperelastic and elastoplastic material models.

4.) A single-step second-order accurate implicit time integration scheme for structural dynamics.

- Spectrally superior to the widely-used Newmark-β and HHT-α methods.
- Unified time integration scheme for fluid-structure interaction.

5.) A single-step third-order accurate explicit scheme for structural dynamics and wave propagation.

Teaching experience

1.) **Fluid Flow (EGF320):** ***Full module delivery***.
Course content: fundamentals of fluid flow; internal flows; extenal flows; fluid kinematics.

2.) **Advanced Structural Analysis (EGF316):** ***Full module delivery***.
Course content: basics of stress and strain; section properties; stresses in cylinders; rotating discs; theories of failure; stress concentration effects; fatigue and linear elastic fracture mechanics.

3.) **Fluid-Structure Interaction (EGEM07):** Lectures on the aspects of computer modelling for fluid-structure interaction.

4.) **Engineering Analysis I (EG189):** Tutorials on Sets, Functions, Derivatives, Integrals and Matrix Algebra.

5.) **Engineering Analysis II (EG190):** Tutorials on Vector Algebra, Complex Numbers, Differential Equations, Multivariate Functions, and Sequences and Series.

6.) **Engineering Design I (EG165) & II (EG263):** Lab on Design principles, Material selection, and SolidWorks.

7.) **Finite Element Method (EG323):** Lab on Programming in MATLAB for basic FEM.

8.) **Computational Plasticity (EGIM08):** Lab on Programming in MATLAB for elastoplastic material models, and ELFEN software.

9.) **Civil Laboratory I (EG107) & II (EG125):** Fluids Lab, Concrete Lab, AutoCAD and SolidWorks.

Supervising experience

Undergraduate level:

1.) Nathan Jones, *Stress analysis of thin-walled aerospace structures using ANSYS*. **Awarded in 2017**.

Masters level:

1.) Aleksander Lovrić, **MSc**, *On projection-type fractional step methods for incompressible fluid flow*. **Awarded in 2016**.

2.) Leidy Suárez González, **MSc**, *Efficient algorithms for detecting cut-cells and obtaining optimal quadrature points*. **Awarded in 2015**.

3.) Farhad Mani, **MSc**, *Isogeometric least-squares method for impact problems*. **Awarded in 2014**.

Doctorate level:

1.) Alberto Coccarelli, **PhD**, *Modelling fluid-structure interaction phenomenon in human arteries.*
Co-supervisors: Prof. Perumal Nithiarasu, Dr. Dimitris Parthimos. **Awarded in 2018**.

2.) Rui Liang, **PhD**, *Simulation of hydrodynamic interaction of flexible fibres in fluid flow.*
Co-supervisors: Prof. Wulf G. Dettmer, Prof. Djordje Perić. **Awarded in 2018**.

3.) Hoang Quang, **PhD**, *A computational multiscale approach to the micro-discrete to macro-continuum transition.*
Co-supervisors: Prof. Eduardo De Souza Neto, Prof. Wulf G. Dettmer. Year started: 2015. On-going.

4.) Peter Hall, **EngD**, *Computer simulation of hydraulic valves in automobile engines.*
Co-supervisors: Prof. Wulf G. Dettmer, Prof. Djordje Perić. Year started: 2016. On-going.

5.) Aleksander Lovrić, **PhD**, *Phase-field modelling for multiphase flows.*
Co-supervisors: Prof. Wulf G. Dettmer, Prof. Djordje Perić. Year started: 2017. On-going.

6.) Mashid Ranjbarestalkhjani, **PhD**, *Advanced Modelling of Material Behaviour for Civil Engineering Design.*
Co-supervisors: Prof. Djordje Perić, Prof. Wulf G. Dettmer. Year started: 2017. On-going.

Research funding

1.) 2017-2018: **£49,000** as the sole researcher in the project funded by Three Cliffs Geomechanical Analysis Limited, Swansea, United Kingdom.

2.) 2013-2017: **£250,000** as the sole researcher in the industrial project funded by Schaeffler Technologies AG & Co. KG, Germany.

List of publications

Articles in scientific journals

J.12.) **C. Kadapa.** *A new semi-implicit scheme for elastodynamics and wave propagation in nearly and truly incompressible materials.*
Under review.

J.11.) **C. Kadapa.** *A fully-explicit finite element scheme for laminar incompressible Navier-Stokes equations using LBB-stable Bézier elements*.
Under review.

J.10.) **C. Kadapa.** *Novel quadratic Bézier triangular and tetrahedral elements using existing mesh generators: Extension to nearly incompressible implicit and explicit elastodynamics in finite strains*. INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING. DOI: 10.1002/nme.6042
Impact Factor: 2.591. Google scholar citations: 1.

J.9.) **C. Kadapa.** *Novel quadratic Bézier triangular and tetrahedral elements using existing mesh generators: Applications to linear nearly incompressible elastostatics and implicit and explicit elastodynamics.* INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING, Vol. 117, pp. 543-573, 2019.
Impact Factor: 2.591. Google scholar citations: 1.

J.8.) A. Lovrić , W. G. Dettmer, **C. Kadapa**, D. Perić. *A new family of projection schemes for the incompressible Navier-Stokes equations with control of high-frequency damping*. COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING, Vol. 339, pp. 160-183, 2018.
Impact Factor: 4.441. Google scholar citations: 0.

J.7.) **C. Kadapa**, W. G. Dettmer, D. Perić. *A stabilised immersed framework on hierarchical b-spline grids for fluid-flexible structure interaction with solid-solid contact*. COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING, Vol. 335, pp. 472-489, 2018.
Impact Factor: 4.441. Google scholar citations: 7.

J.6.) **C. Kadapa**, W. G. Dettmer, D. Perić. *On the advantages of using the first-order generalised-alpha scheme for structural dynamic problems*. COMPUTERS AND STRUCTURES, Vol. 193, pp. 226-238, 2017.
Impact Factor: 2.887. Google scholar citations: 8.

J.5.) **C. Kadapa**, W. G. Dettmer, D. Perić. *A stabilised immersed boundary method on hierarchical b-spline grids for fluid-rigid body interaction with solid-solid contact*. COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING, Vol. 318, pp. 242-269, 2017.
Impact Factor: 4.441. Google scholar citations: 17.

J.4.) W. G. Dettmer, **C. Kadapa**, D. Perić. *A stabilised immersed boundary method on hierarchical b-spline grids*. COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING, Vol. 311, pp. 415-437, 2016.
Impact Factor: 4.441. Google scholar citations: 16.

J.3.) **C. Kadapa**, W. G. Dettmer, D. Perić. *Subdivision based mixed methods for isogeometric analysis of linear and nonlinear nearly incompressible materials*. COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING, Vol. 305, pp. 241-270, 2016.
Impact Factor: 4.441. Google scholar citations: 14.

J.2.) **C. Kadapa**, W. G. Dettmer, D. Perić. *A fictitious domain/distributed Lagrange multiplier based fluid-structure interaction scheme with hierarchical B-Spline grids*. COMPUTER METHODS IN APPLIED MECHANICS AND ENGINEERING, Vol. 301, pp. 1-27, 2016.
Impact Factor: 4.441. Google scholar citations: 31.

J.1.) **C. Kadapa**, W. G. Dettmer, D. Perić. *NURBS based Least-Squares Finite Element Methods for Fluid and Solid mechanics*. INTERNATIONAL JOURNAL FOR NUMERICAL METHODS IN ENGINEERING, Vol. 101, pp. 521-539, 2015.
Impact Factor: 2.591. Google scholar citations: 7.

Conference presentations

C.12.) **C. Kadapa**. *Novel unified finite element schemes for computational solid mechanics based on Bézier elements*, UK Association for Computational Mechanics 2019 Conference, London, April, 2019.

C.11.) A. Lovrić, W. G. Dettmer, D. Perić, **C. Kadapa**. *Phase-field modelling*, IGA 2018: Integrating Design and Analysis, Texas, USA, October 2018.

C.10.) D. Perić, W. G. Dettmer, **C. Kadapa**. *Embedded interface methods for fluid-structure interaction: Algorithms and Applications*, 6th European Conference on Computational Mechanics (ECCM 6), 7th European Conference on Computational Fluid Dynamics (ECFD 7), Glasgow, UK, June 2018.

C.9.) W. G. Dettmer, D. Perić, **C. Kadapa**, A. Lovrić. *An immersed boundary finite element method for fluid-structure interaction and other applications*, 6th European Conference on Computational Mechanics (ECCM 6), 7th European Conference on Computational Fluid Dynamics (ECFD 7), Glasgow, UK, June 2018.

C.8.) **C. Kadapa**, W. G. Dettmer, D. Perić. *A robust stabilised immersed finite element framework for complex fluid-structure interaction*, 19th International Conference on Finite Elements in Flow Problems, Rome, Italy, April 2017.

C.7.) **C. Kadapa**, W. G. Dettmer, D. Perić. *CutFEM on hierarchical B-Spline cartesian grids with applications to fluid-structure interaction*, ECCOMAS Congress 2016, Crete Island, Greece, June 2016.

C.6.) W. G. Dettmer, **C. Kadapa**, D. Perić. *Body-fitted or Immersed, Monolithic or Partitioned? Aspects of Computational Fluid-Structure Interaction*, VII International Conference on Textile Composites and Inflatable Structures, Barcelona, Spain, October 2015.

C.5.) **C. Kadapa**, W. G. Dettmer, D. Perić. *Inf-sup Stable Displacement-Pressure Combinations for Isogeometric Analysis of Nearly Incompressible Materials*, III International Conference on Isogeometric Analysis 2015, Trondheim, Norway, June 2015.

C.4.) W. G. Dettmer, **C. Kadapa**, D. Perić. *Formulation and performance study of an immersed boundary method on a hierarchical B-Spline grid*, VI International Conference on Coupled Problems in Science and Engineering, Venice, Italy, May 2015.

C.3.) **C. Kadapa**, W. G. Dettmer, D. Perić. *Fluid-flexible solid interaction with immersed boundary method based on hierarchical B-Spline grid*, VI International Conference on Coupled Problems in Science and Engineering, Venice, Italy, May 2015.

C.2.) **C. Kadapa**, W. G. Dettmer, D. Perić. *Fluid-structure interaction with immersed boundary method based on hierarchical B-Spline based Eulerian grid*, ACME-UK 23rd Conference on Computational Mechanics, Swansea, United Kingdom, April 2015.

C.1.) **C. Kadapa**, W. G. Dettmer, D. Perić. *Mixed Methods for Isogeometric Analysis of Nearly Incompressible Materials*, XII International Conference on Computational Plasticity, Barcelona, September 2013.

Invited talks

T.1.) *Fluid-structure interaction schemes based on hierarchical B-Spline cartesian grids*, Durham University, Durham, December 2015.